5.0 FEATHER RIVER FLOODPLAIN AND WATER SURFACE PROFILES

5.1 INTRODUCTION

The Department of Water Resources required new floodplain mapping, compatible with the USACE hydrology of the Yuba-Feather system, which was updated in 1999. The immediate purpose was to support DWR's effort to relicense the Oroville Facilities with the Federal Energy Regulation Commission. However, it also filled a need for mapping for the Federal Emergency Management Agency flood insurance program, and was performed to FEMA standards to make the product acceptable for use in flood insurance rate maps and for other FEMA-related purposes (pers. comm., Cheng, 2003).

This report briefly relates the conditions of the mapping study, the participants, the input data and the method of conducting the studies. The report contains background information, a short description of the study and an orientation map embedded in the text. Appended are a key map, three foldout sheets of water surface profiles, and 12 sheets of floodplain/floodway maps.

5.1.1 Background Information

The California Department of Water Resources requested assistance from the Sacramento District of the U.S. Army Corps of Engineers to prepare a floodplain mapping study along the Feather River. The purpose of the study is to provide floodplain mapping for the Feather River from Oroville Dam to the mouth of the Yuba River.

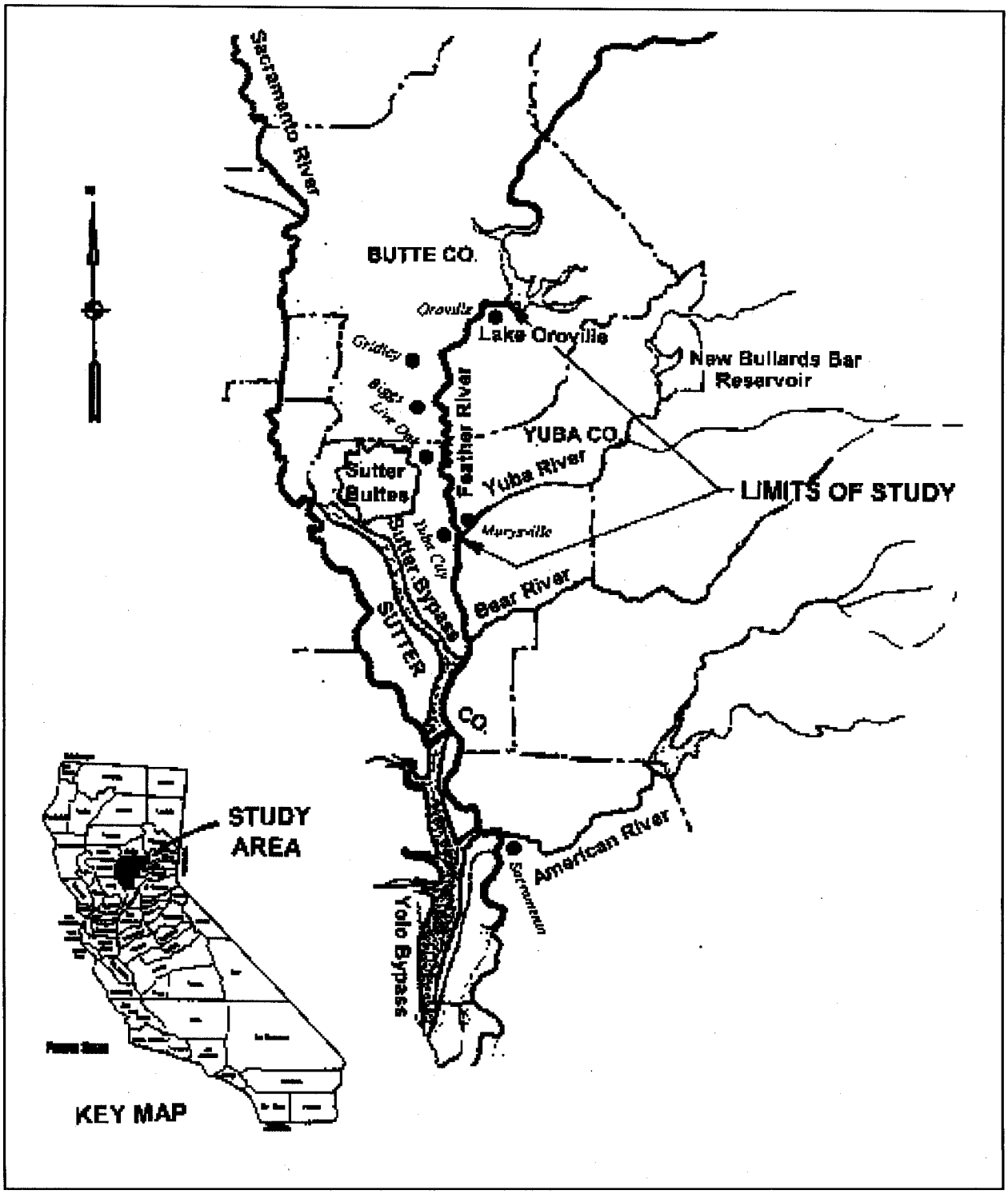
5.1.1.1 Statutory/Regulatory Requirements

The Federal Emergency Management Agency manages the National Flood Insurance Program. In California, DWR is a Cooperating Technical Partner with FEMA in supporting this program. As part of the partnership agreement, DWR has performed this detailed floodplain study for the upper Feather River using NFIP standards. The study will be used for the NFIP in preparing flood insurance rate maps (pers. comm., Christensen, 2003).

5.1.1.2 Study Area

The study reach includes parts of Butte, Sutter, and Yuba Counties. From Oroville Dam downstream for about 27 river miles the river is in Butte County. For the next mile downstream, to Honcut Creek, the river divides Butte and Sutter Counties, with Sutter on the west and Butte on the east. From Honcut Creek 17 miles to the mouth of the Yuba and continuing downstream, the Feather River divides Sutter and Yuba Counties, with Sutter on the west and Yuba on the east. Major communities along the Feather River in the study area include Oroville, Biggs, Gridley, Live Oak, Yuba City, and Marysville. Oroville lies

just downstream of the Oroville Dam on the east side of the river. Biggs, Gridley, and Live Oak are located west of the River further downstream. Finally, at the end of the study reach where the Yuba River joins the Feather, Yuba City is on the west and Marysville is on the east. Figure 1.1.2-1 illustrates the study area (USACE 2002a).



Source: USACE 2002b.

Figure 5.1-1. Study Area and Limits.

5.4 METHODOLOGY

5.4.1 Study Design

This study modeled flows in the Feather River from Oroville to the Yuba River for flood events having a 10%, 2%, 1%, and 0.2% chance of occurring in any year, to obtain water surface profiles (backwater curves), floodplain boundaries for the 1% (100-yr) and 0.2% (500-yr) floods, and floodway limits for the 1% flood.

A second study covering the reach from the mouth of the Feather at the Sacramento River to the mouth of the Yuba River is underway and will be completed in late 2003. The second study will also be performed to FEMA standards (pers. comm., Cheng, 2003).

5.4.2 How And Where The Study Was Conducted

The Sacramento District, USACE, conducted the study in Sacramento using the three computer programs described below.

Input data to the study included:

- Feather River inflow hydrographs from the Comprehensive Study;
- Local inflow hydrographs from the Comprehensive Study, including the Yuba River, Honcut Creek, Jack and Simmerly Sloughs, and Deer Creek;
- Topographic data from the Comprehensive Study, surveyed in 1999, including digital terrain models and two-foot contours;
- Bridge plans from the California Department of Transportation;
- Plans for Oroville Facilities structures from DWR;
- Aerial photos from the Comprehensive Study and USGS quad maps used as bases for floodplain maps;
- Manning's n-values determined from aerial photography and field observation, sensitivity tested to assess the validity of n-value selections.

The floodplain study, using the Comprehensive Study hydrographs, routed flows both with XRATE, a composite hydrologic routing and hydraulic rating program that accommodates levee breaks and weir flow, and HEC-RAS, the USACE's one-dimensional steady/unsteady flow program. XRATE was used primarily to route flows through the Feather River system; HEC-RAS was used, in the steady-state mode, to determine water surface profiles in the main river and some overbank areas. The results of XRATE and HEC-RAS were compared, and input flows and storage losses were adjusted to make the results of the two models reasonably consistent. The study also used XRATE to model overbank storage around Oroville, but used FLO-2D to model the large right bank overflow area.

Form loss and boundary conditions were covered by close coordination between cross section data, aerial photography and observations in the field. Starting

water surface elevations were based upon normal flow depth at the mouth of the Bear River, an adequate distance downstream of the study reach so that the normal depth assumption would not affect the study reach.

Water surface elevations for overflow areas near Oroville were determined based upon overflow ratings of the flow leaving the overflow area, using either Manning's equation or the weir equation as appropriate.

When modeling was complete, the modeled water surface was compared to the existing ground surface. Flood boundaries were located at the intersection of these two surfaces and adjusted for reasonable smoothness and elimination of discontinuities. This was done with 2-foot contour maps from the Comprehensive Study topography, except that overbank areas from River Mile 64 to River Mile 56 were drawn using USGS contour maps. The left overbank area from River Mile 56 to River Mile 55 is based on backwater from the main river channel. This was done with the use of 2-foot contour maps. This area and other areas near Highway 70 were field checked (USACE 2002a).

5.5 STUDY RESULTS

The study delineates the 10%, 2%, 1%, and 0.2% flood profiles, the 1% and 0.2% flood boundaries, and the 1% floodway. It was prepared using FEMA standards for study contractors preparing information for flood insurance rate maps.

The USACE study report contains ten foldout water surface profiles on scales of 1" = 2000' horizontally and 1" = 10" or 1" = 20' vertically, and nine 36"x44" maps at 1" = 1000' delineating the floodplains and floodway. The floodplain/floodway maps are based on aerial photographs where available from the Comprehensive Study, or U.S.G.S. quad maps in other areas. Appendix A of this report includes a reduction of that data, including three half-scale 11"x17" profiles and 12 quarter-scale (1" = 4000') floodplain maps on a quad map base. Figure A-1 is a key map for the profiles and floodplain maps.

5.5.1 Floodplain Delineation

The floodplain represents the maximum extent of inundation for the event depicted, either the 1% flood or the 0.2% flood. For the 1% flood the water does not cross Highway 70 to the east. However, for the 0.2% event water does cross Highway 70 at a few locations. These locations are noted on the maps but are not delineated because of possible flooding from other sources that were not studied.

Backwater effects of the Feather River for Honcut Creek are noted but not shown because there has been no detailed study on Honcut Creek, which could have a significant effect on the extent of the floodplain. Backwater effects on Jack and

Simmerly Sloughs are also not shown, but previous studies showed that the sloughs' water profiles are dependent on Feather River backwater. The condition is noted on the maps.

Flood boundaries shown south of the West Interception Canal and west of the Wadsworth Canal are not based completely on the modeling, which did not cover this area. The modeling of the 0.2% flood showed that in the southeast corner of this area (where the Sutter Bypass and Wadsworth Canal join) there are considerable water depths. The water surface elevation for the rest of this area is based upon these depths and no analysis, and should therefore be considered approximate (USACE 2002a).

5.5.2 Floodway Delineation

The floodway developed and depicted on the maps is that portion of the flowage area that must remain free of encroachment to avoid exceeding a one-foot rise in water surface (FEMA 2001). The location of the floodway was developed because it is of particular interest to FEMA.

To meet the FEMA standards for floodways:

- The floodway must be based on the 1% flood.
- The width of the entire flowage area is assumed to be reduced by encroachments to derive a floodway than flows not more that one foot deeper than the unreduced width. (This is the "one-foot surcharge" condition.)
- Flow bounded by steep surfaces does not exhibit significant width change when the stage is increased one foot, so the floodway is taken to be at the original flowage area position when bounded by a steep surface such as a levee or channel bank.
- Where the floodway can be encroached on both sides, it must be done so that equal volumes of flow are cut off on each side (This is the "equal conveyance reduction" condition.)(FEMA 2001).

From Oroville Dam downstream for about six miles (to Highway 70) the channel is well defined with steep slopes. An attempt to define the floodway boundary by encroachment analysis using equal conveyance reduction showed little change from the boundaries of the 1% floodplain, probably because the 1% flow is contained in the channel. The floodway in this section of the river was therefore drawn the same as the 1% floodplain boundaries with the exception of a few locations where the floodway boundary was manually smoothed at small storage areas that do not convey flow. These small storage areas were not included in the HEC-RAS model and therefore their elimination from the floodway does not increase the computed water surface profile (USACE 2002a).

From about six to nine miles below Oroville Dam, encroachment analysis was performed using equal conveyance reduction. In order to maintain smooth hydraulic transitions and avoid negative surcharges, most cross sections in this

reach did not have a one-foot surcharge. Because there is little or no right overbank flow in this section of the river, most of the width of encroachment occurred in the left overbank area (USACE 2002a).

A floodway is not applicable from about eight to 15 miles below Oroville Dam because of the multiple locations of split flow through the extensive dredger tailings southwest of Oroville (USACE 2002a).

Encroachment analysis was performed by equal conveyance reduction for the next two miles downstream. The analysis shows that the 1% event can be contained in the channel without exceeding the 1-foot maximum surcharge (USACE 2002a).

From 17 miles below Oroville Dam to Honcut Creek, equal conveyance reduction was not used because the existing levee forms the right floodway boundary and only the left overbank area can be encroached. Determining the floodway in this reach proved difficult because the flow with encroachment to produce one foot of surcharge remained in the channel at some cross sections and at others it did not. In order to maintain a smooth floodway boundary, the floodway was interpreted across the sections of contained flow. The maximum surcharge at any cross section within this reach was one foot, though for relatively smooth hydraulic transitions not all sections reached the maximum (USACE 2002a).

The floodway below Honcut Creek is shown along the levees, which are continuous on both sides of the river to the end of the study reach (USACE 2002a).

APPENDIX A

PROFILES AND FLOODPLAIN MAPS

The following figures are a condensation of the results of the study. For larger versions of the figures, please refer to the original report of the study, USACE 2002a.

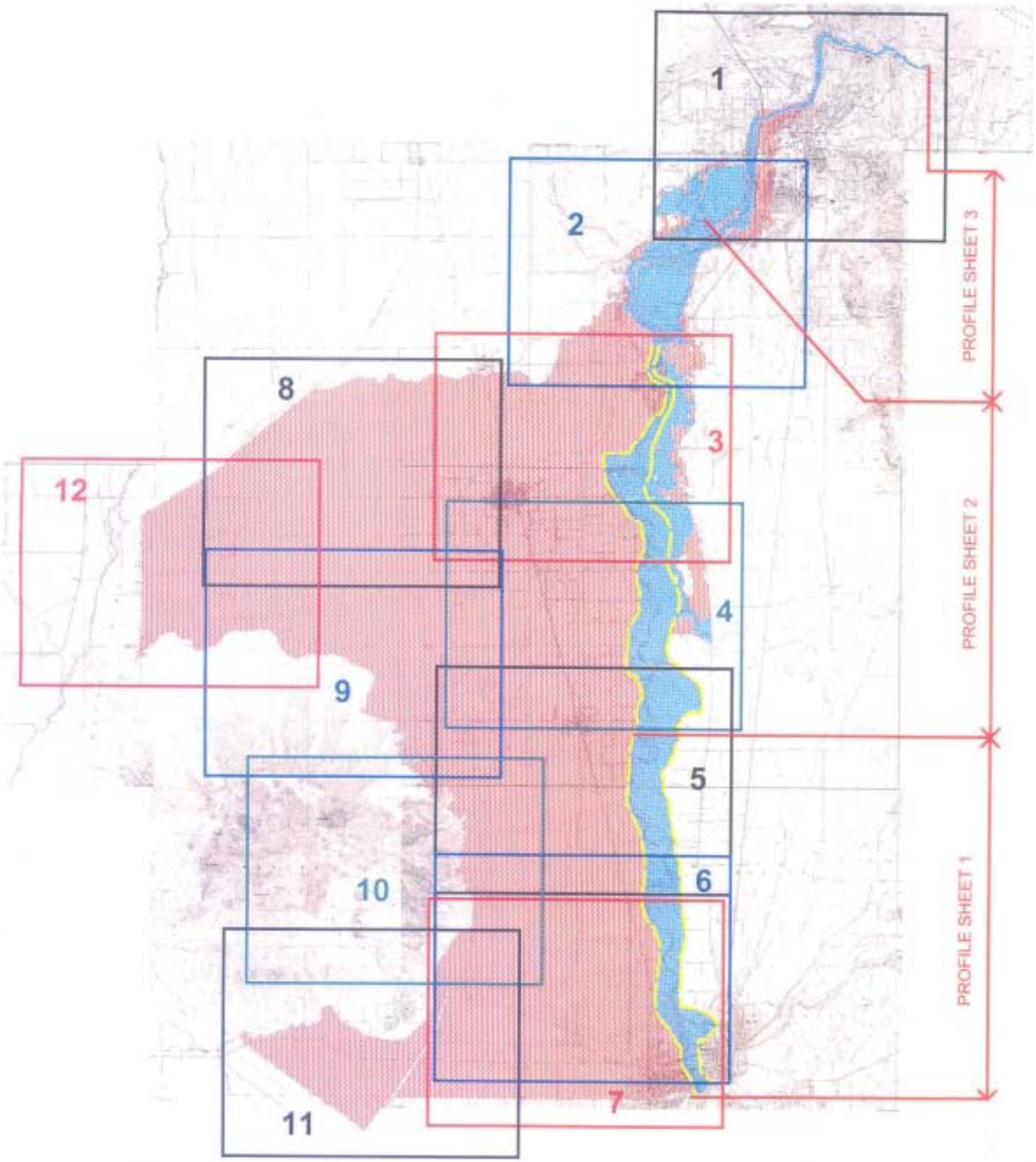


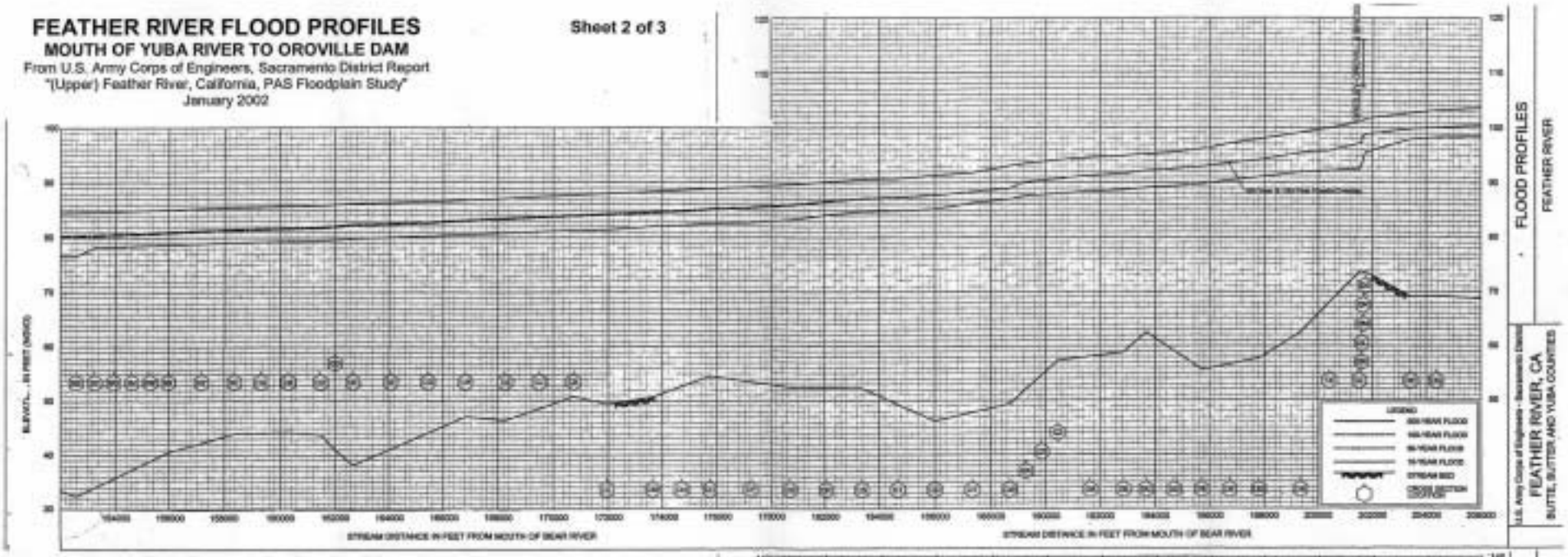
Figure A-1. Layout of Floodplain Maps and Profiles. *Source: USACE 2002a, DWR*

FEATHER RIVER FLOOD PROFILES

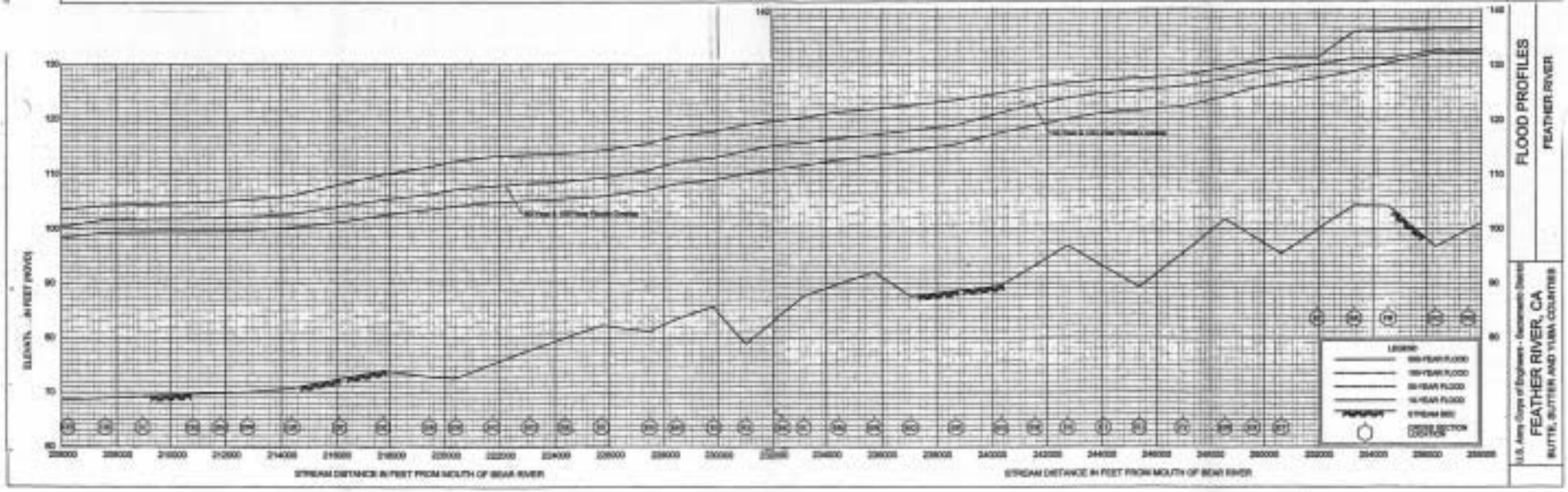
MOUTH OF YUBA RIVER TO OROVILLE DAM

From U.S. Army Corps of Engineers, Sacramento District Report
"(Upper) Feather River, California, PAS Floodplain Study"
January 2002

Sheet 2 of 3



FLOOD PROFILES
FEATHER RIVER
FEATHER RIVER, CA
BUTTE, SUTTER AND YUBA COUNTIES
U.S. Army Corps of Engineers - Sacramento District



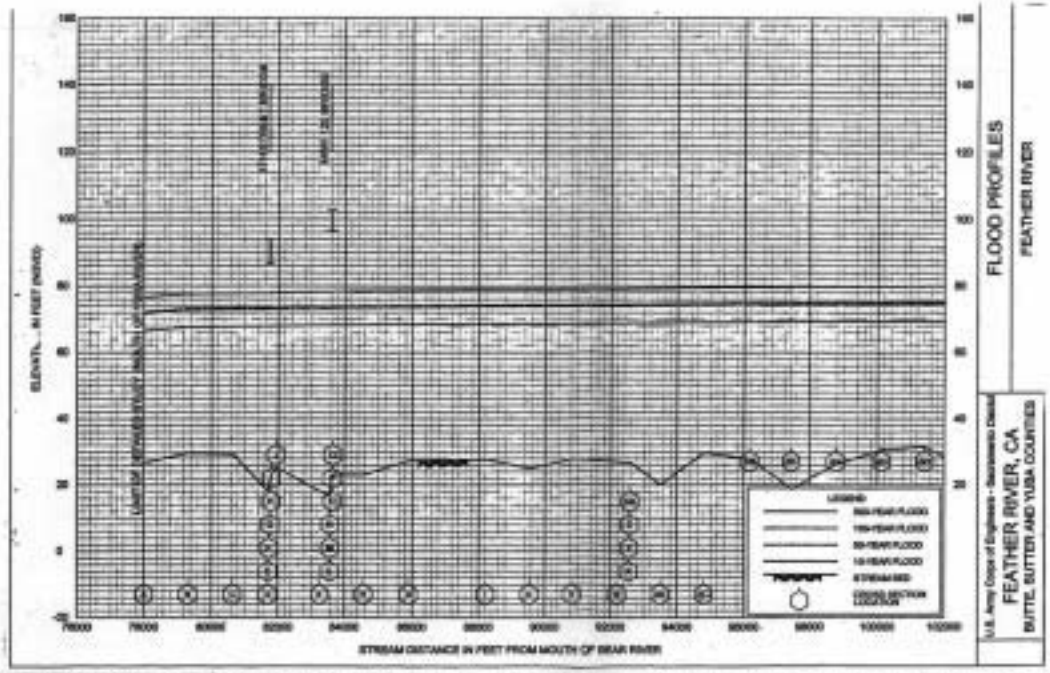
FLOOD PROFILES
FEATHER RIVER
FEATHER RIVER, CA
BUTTE, SUTTER AND YUBA COUNTIES
U.S. Army Corps of Engineers - Sacramento District

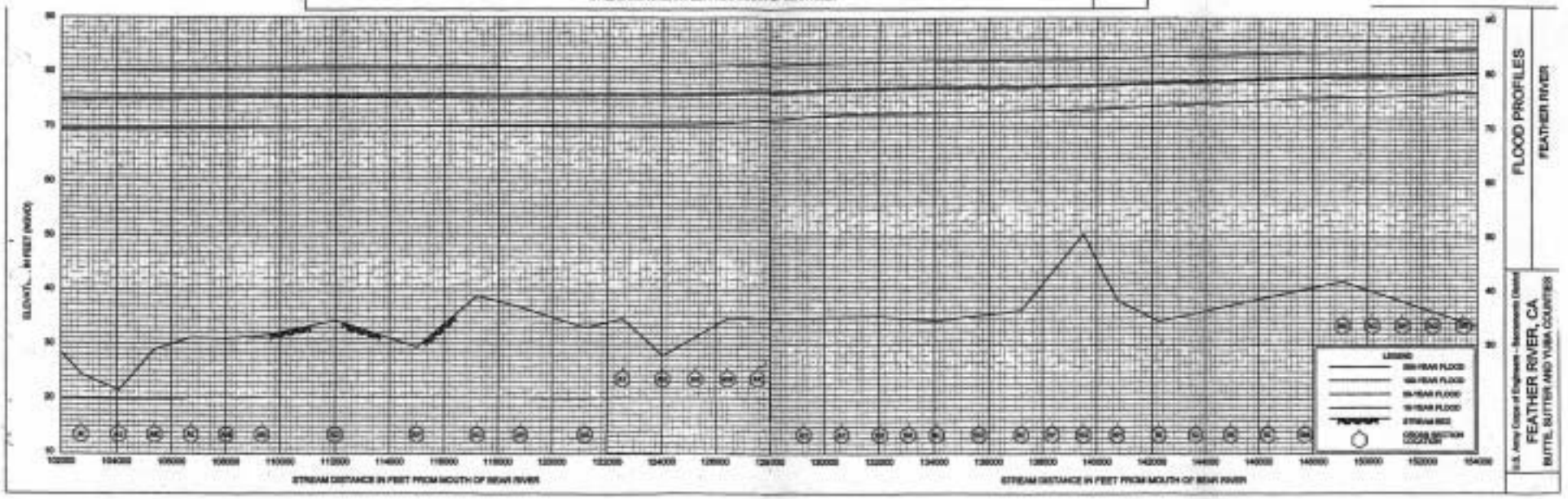
FEATHER RIVER FLOOD PROFILES

MOUTH OF YUBA RIVER TO OROVILLE DAM

From U.S. Army Corps of Engineers, Sacramento District Report
"(Upper) Feather River, California, PAS Floodplain Study"
January 2002

Sheet 1 of 3



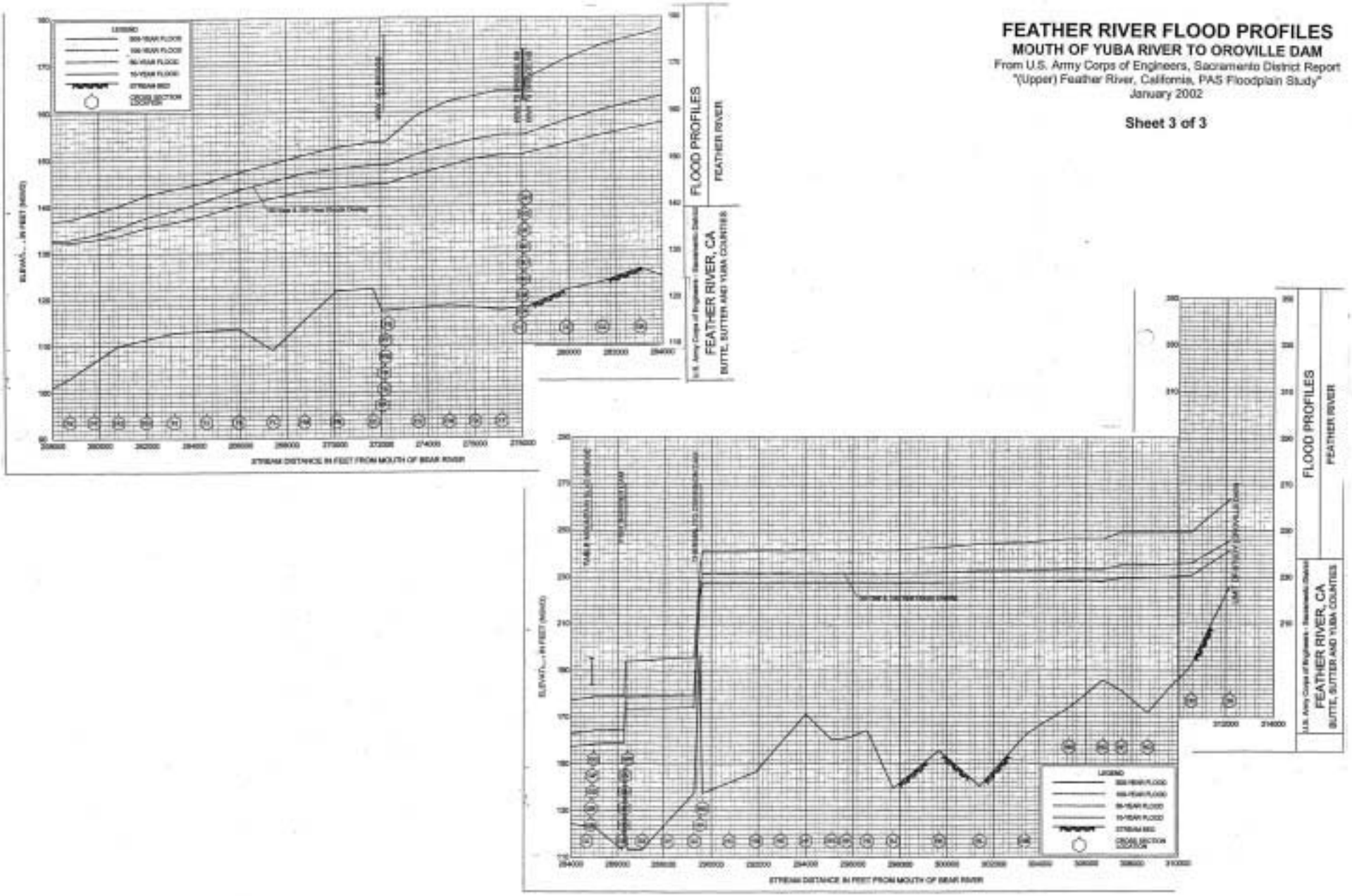


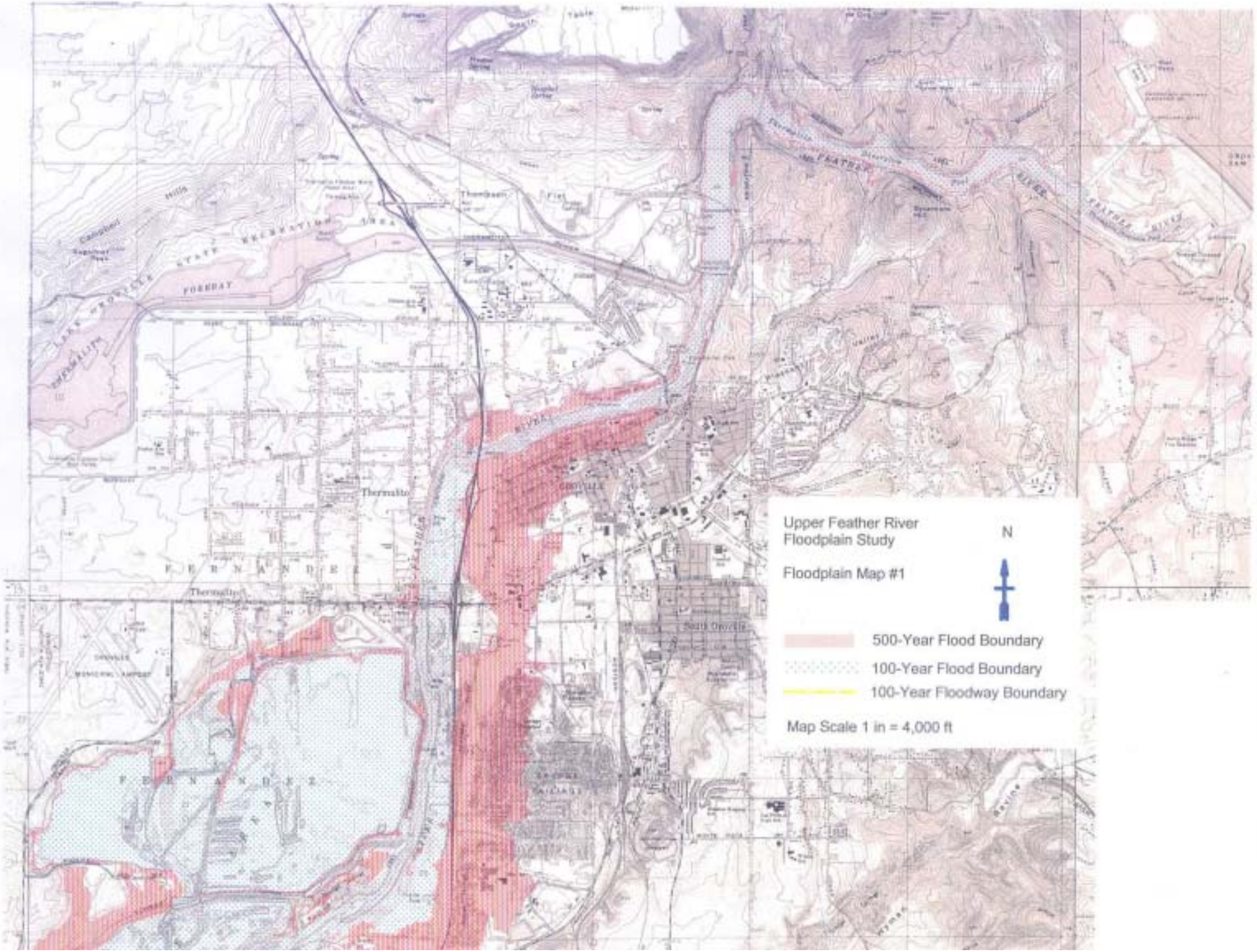
FEATHER RIVER FLOOD PROFILES

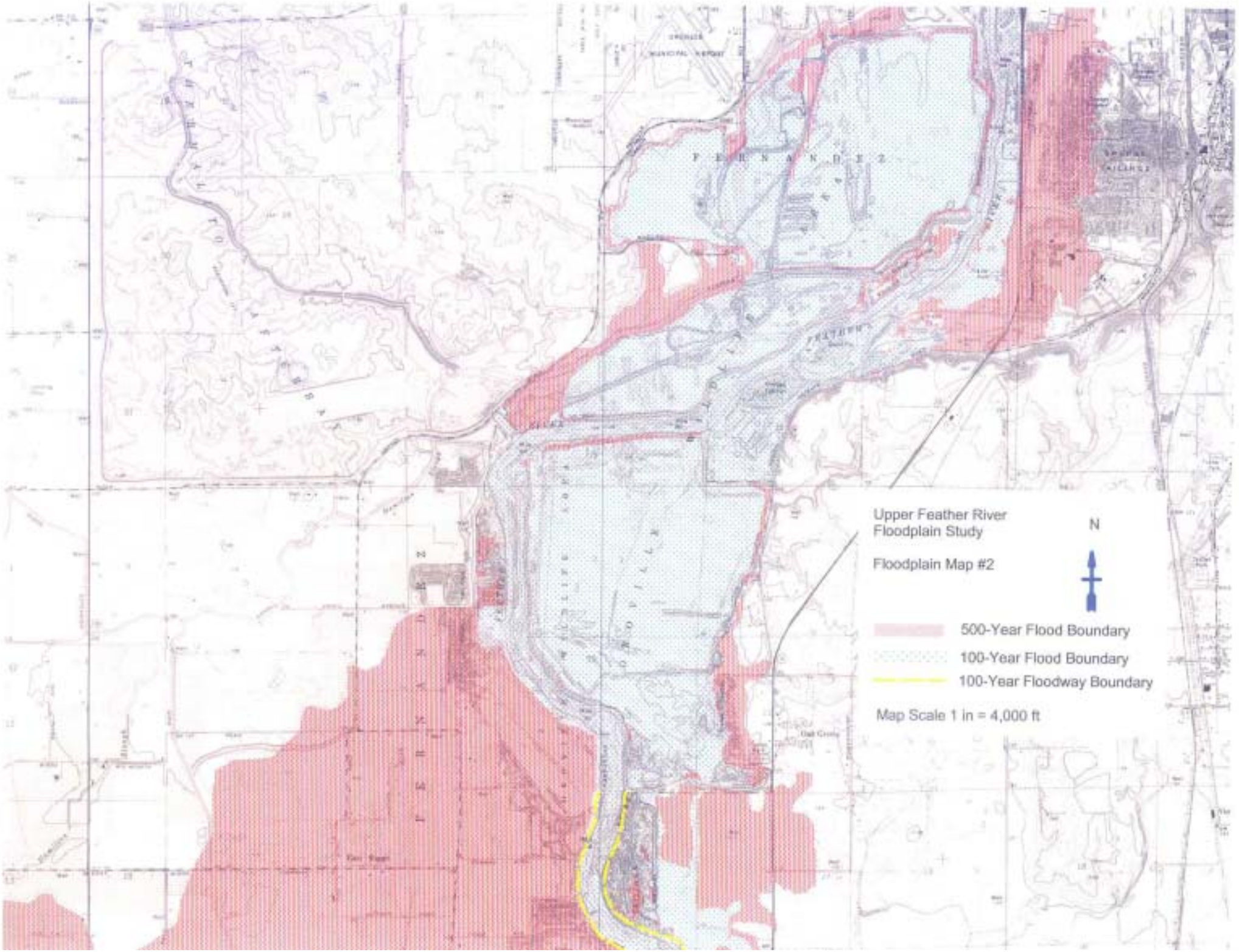
MOUTH OF YUBA RIVER TO OROVILLE DAM

From U.S. Army Corps of Engineers, Sacramento District Report
"(Upper) Feather River, California, PA5 Floodplain Study"
January 2002

Sheet 3 of 3




Upper Feather River
Floodplain Study
Floodplain Map #1
N
500-Year Flood Boundary
100-Year Flood Boundary
100-Year Floodway Boundary
Map Scale 1 in = 4,000 ft
FERNANDEZ
Thermalito
FEATHER RIVER
FOREBAY


Upper Feather River
Floodplain Study
Floodplain Map #2
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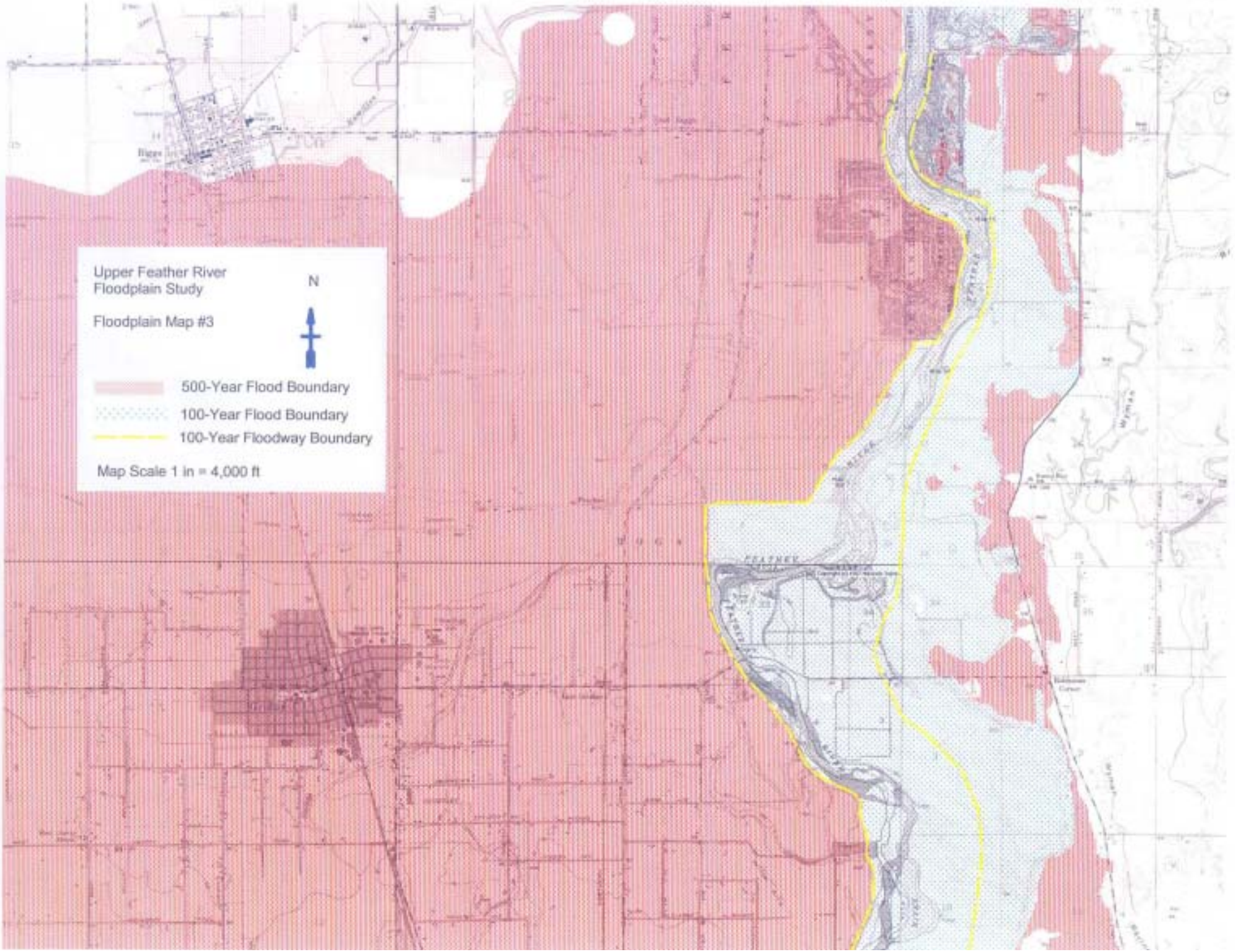
500-Year Flood Boundary
100-Year Flood Boundary
100-Year Floodway Boundary
Map Scale 1 in = 4,000 ft


Upper Feather River
Floodplain Study
Floodplain Map #3
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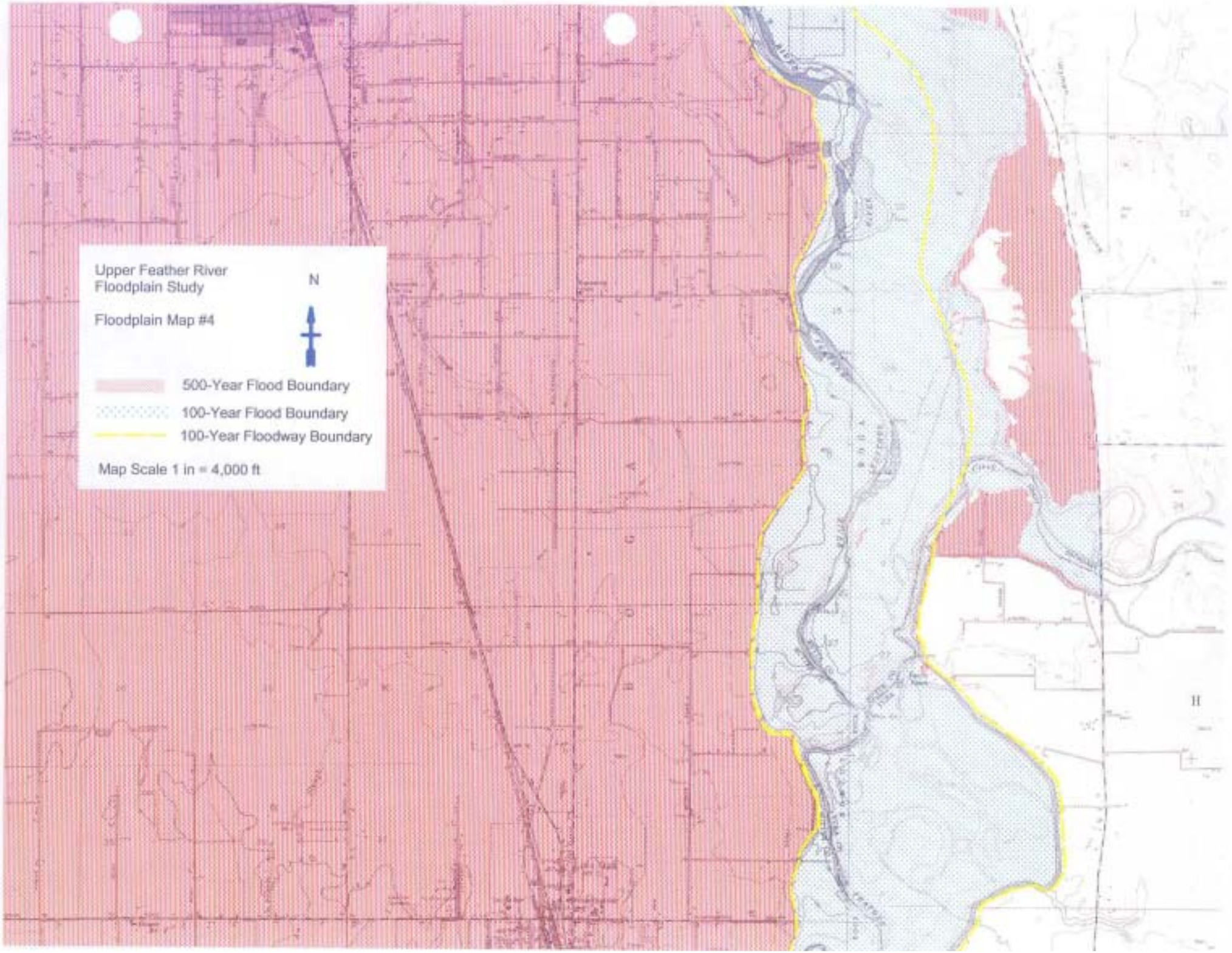
500-Year Flood Boundary
100-Year Flood Boundary
100-Year Floodway Boundary
Map Scale 1 in = 4,000 ft


Upper Feather River
Floodplain Study
Floodplain Map #4
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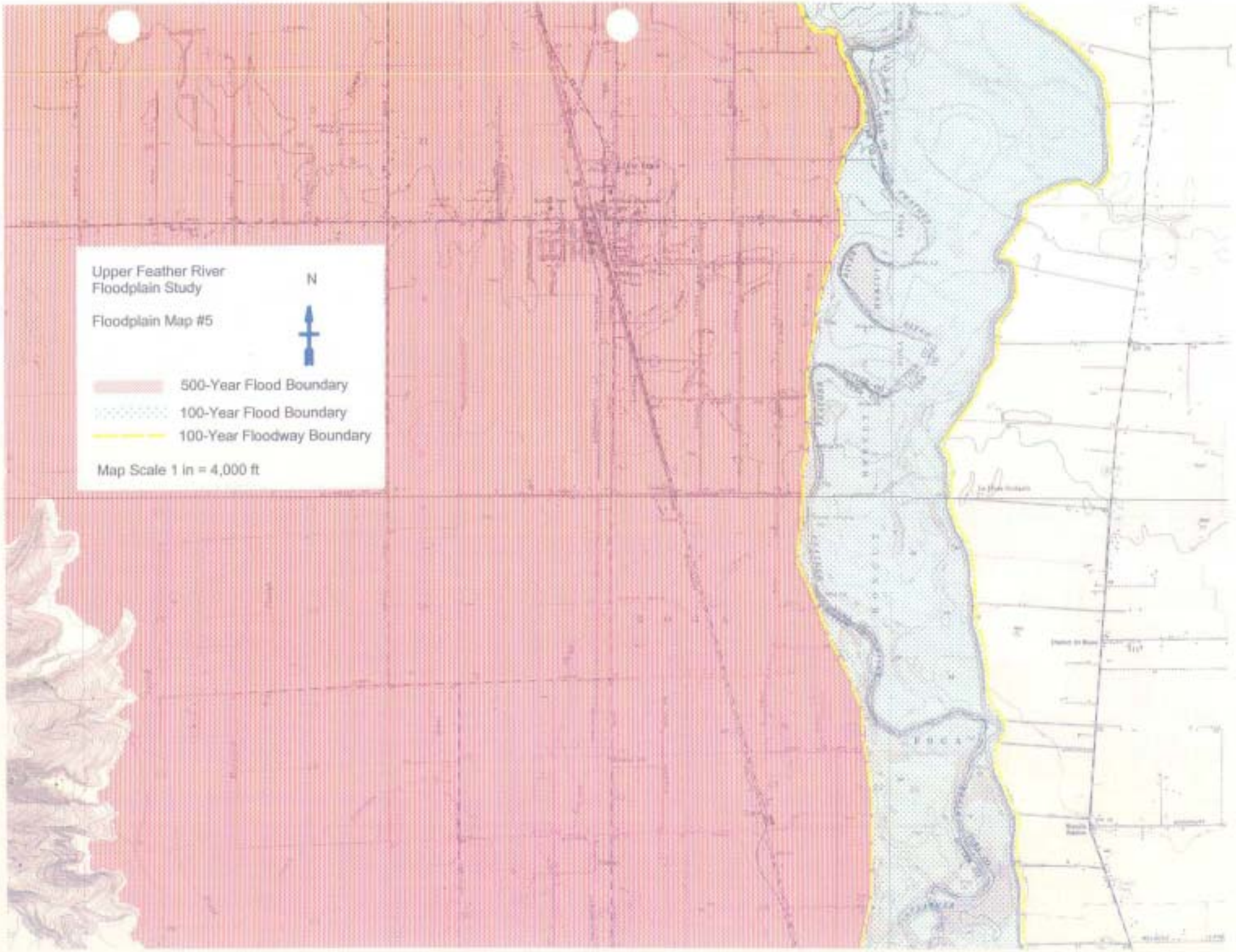
500-Year Flood Boundary
100-Year Flood Boundary
100-Year Floodway Boundary
Map Scale 1 in = 4,000 ft


Upper Feather River
Floodplain Study
Floodplain Map #5
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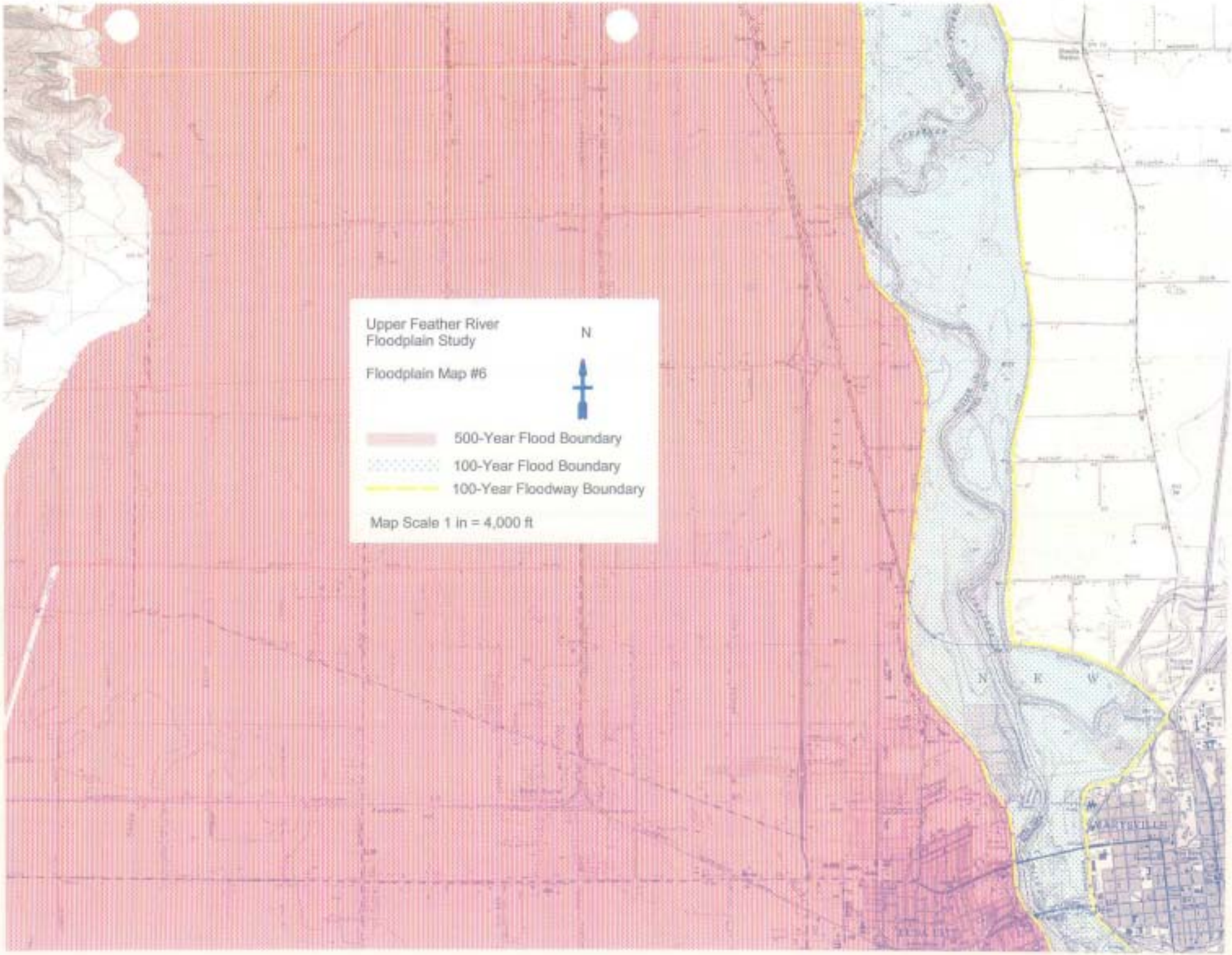
500-Year Flood Boundary
100-Year Flood Boundary
100-Year Floodway Boundary
Map Scale 1 in = 4,000 ft


Upper Feather River
Floodplain Study
Floodplain Map #6
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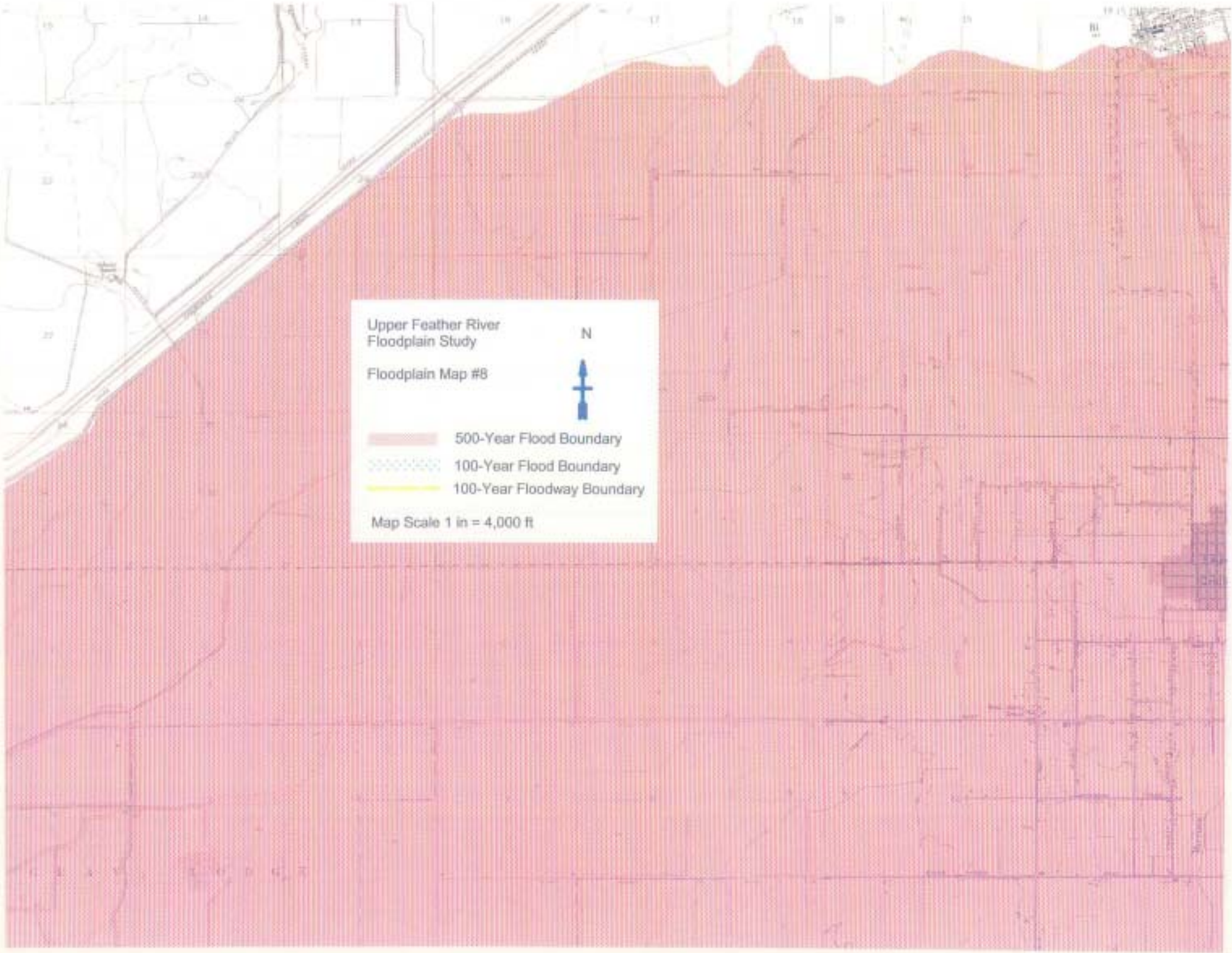
500-Year Flood Boundary
100-Year Flood Boundary
100-Year Floodway Boundary
Map Scale 1 in = 4,000 ft


Upper Feather River
Floodplain Study
Floodplain Map #7
N
500-Year Flood Boundary
100-Year Flood Boundary
100-Year Floodway Boundary
Map Scale 1 in = 4,000 ft
N
E
W


Upper Feather River
Floodplain Study
Floodplain Map #8
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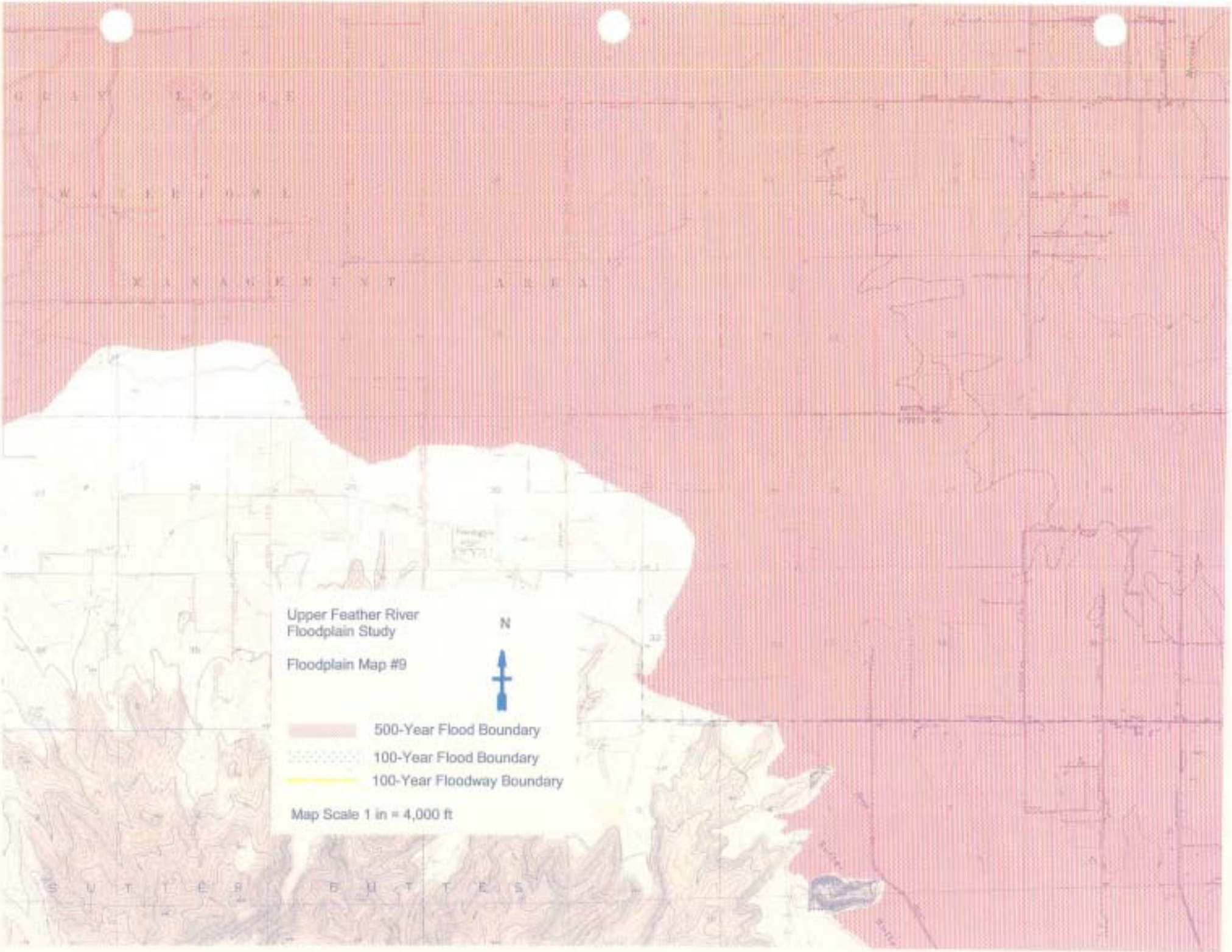
500-Year Flood Boundary
100-Year Flood Boundary
100-Year Floodway Boundary
Map Scale 1 in = 4,000 ft


Upper Feather River
Floodplain Study
Floodplain Map #9
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500-Year Flood Boundary
100-Year Flood Boundary
100-Year Floodway Boundary
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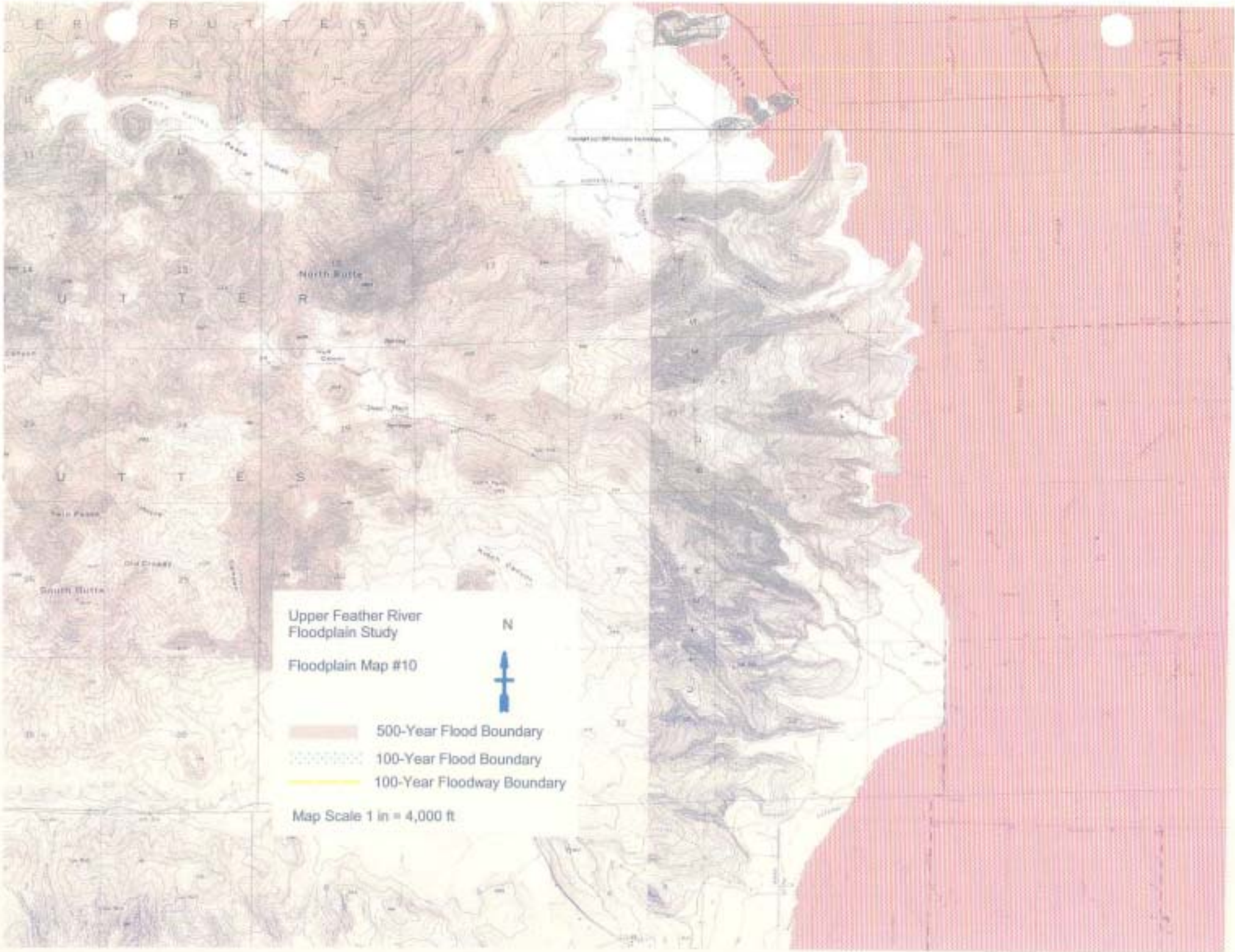
Upper Feather River
Floodplain Study
Floodplain Map #10
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500-Year Flood Boundary
100-Year Flood Boundary
100-Year Floodway Boundary
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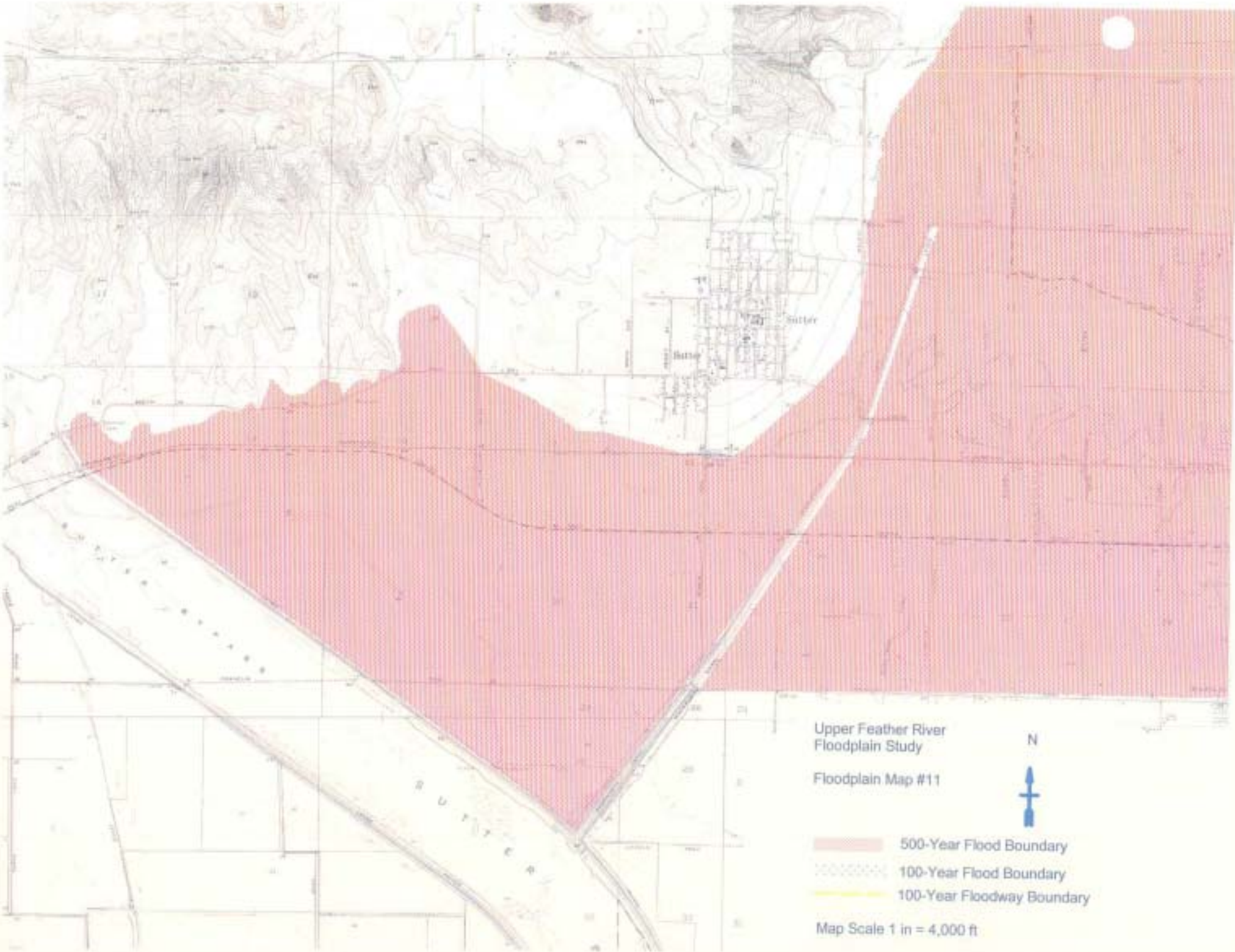
Upper Feather River
Floodplain Study
Floodplain Map #11
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500-Year Flood Boundary
100-Year Flood Boundary
100-Year Floodway Boundary
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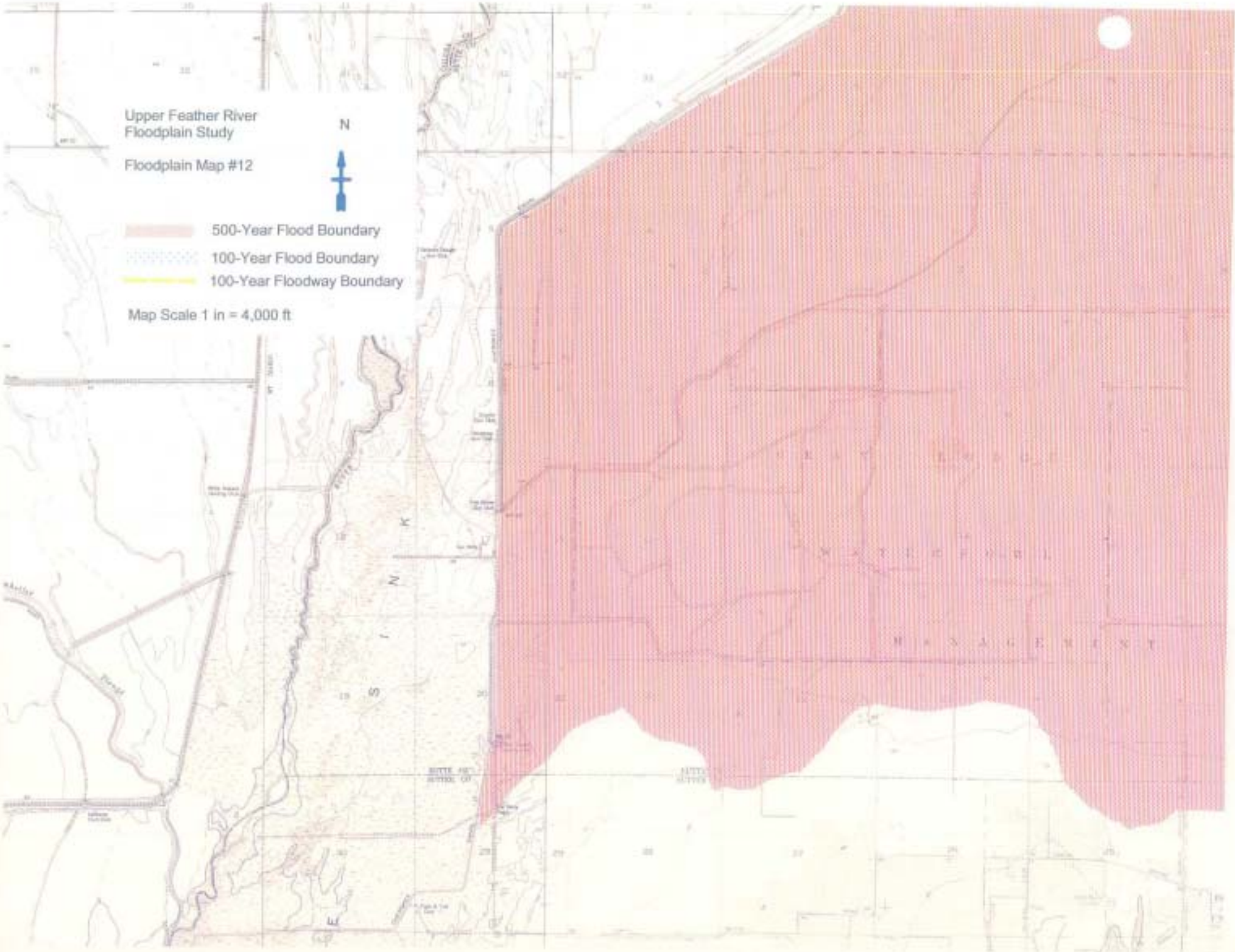
Upper Feather River
Floodplain Study
Floodplain Map #12
N
500-Year Flood Boundary
100-Year Flood Boundary
100-Year Floodway Boundary
Map Scale 1 in = 4,000 ft